TEXAS STATE
INGRAM SCHOOL OF ENGINEERING

E1.06 - Penbot 1

Thomas Denning, Project Manager, Chris Le, Diego Garcia-Mendez
Mr. Lee Hinkle, Dr. William Stapleton

Penbot is an autonomous robot that produces line art.

Project Overview

- Small autonomous vehicle
- Driven by stepper motors
- Moves along a path to leave behind line art drawn by a center-mounted pen.

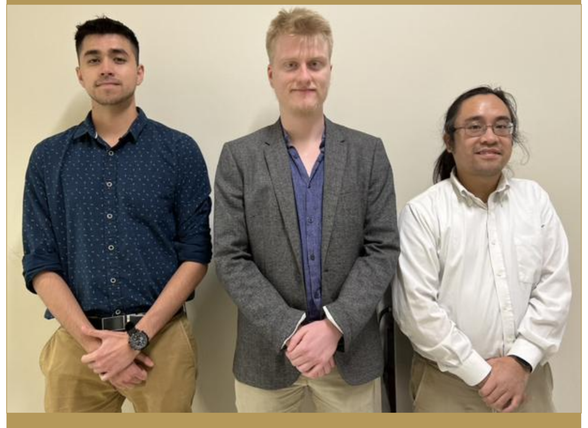
D2 Plan

- Improve stepper motor accuracy
- Implement image processing to stepper motor control instruction set
- Incorporate mobile app UI via Bluetooth
- Incorporate remote control via Bluetooth
- Replace linear voltage regulator with a buck convertor

Project Requirements

- Small size, low-cost, mix of 3D printed, cut sheet, and off-the shelf component construction
- Autonomous - must complete drawings without interaction
- Five Drawings: simple/fast, portrait, geometric, landscape, supersize
- D1 Senior Design Day - demonstrate a functional prototype using 28BYJ-48 steppers to draw simple geometric shapes
- Team must include an interactive control mode

Meet the Team



Diego Garcia-Mendez | Thomas Denning (PM) | Chris Le

Functional Block Diagram

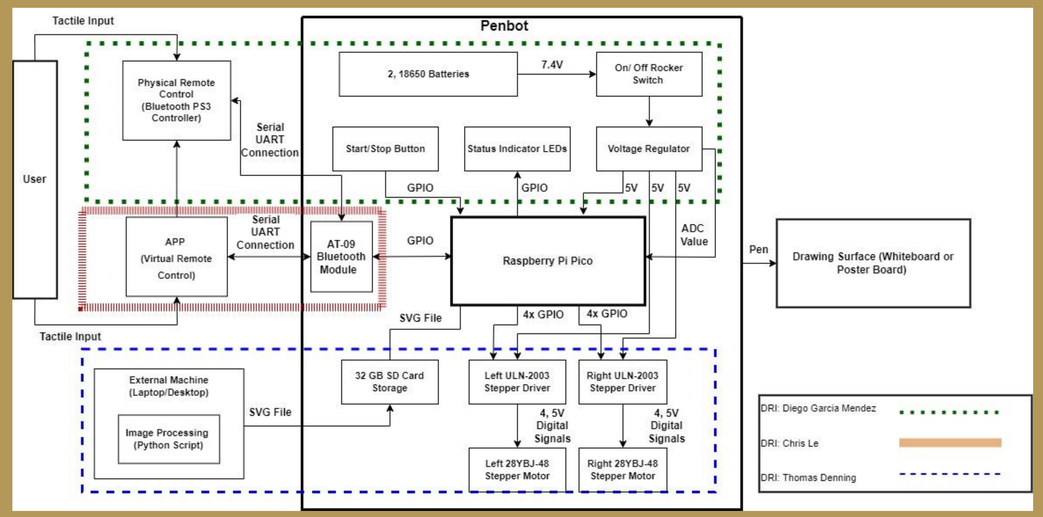
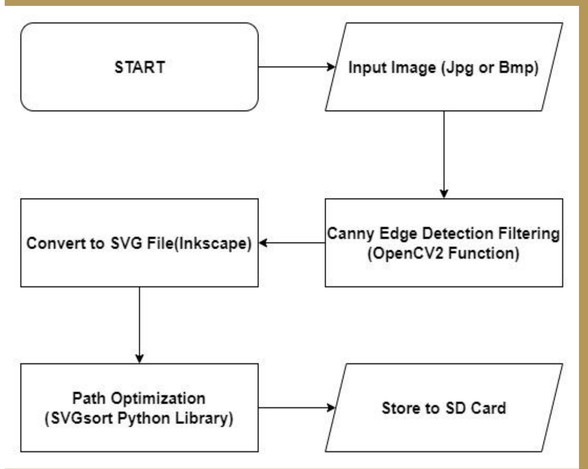
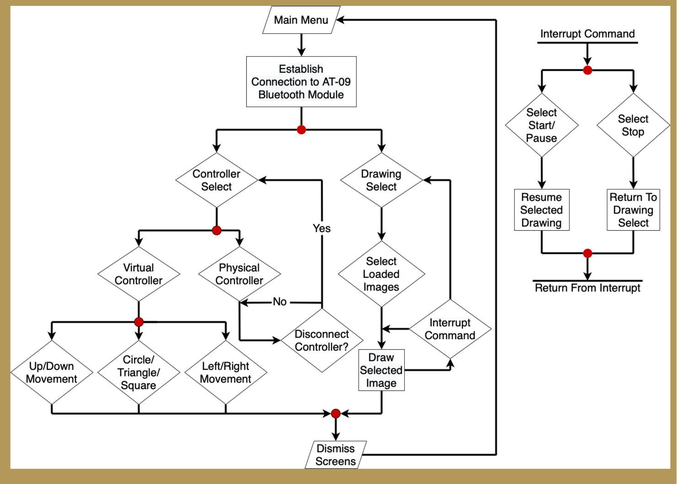


Image Processing Flowchart

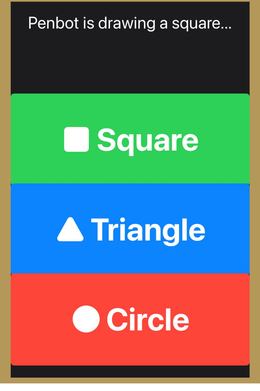


iPhone App Flowchart

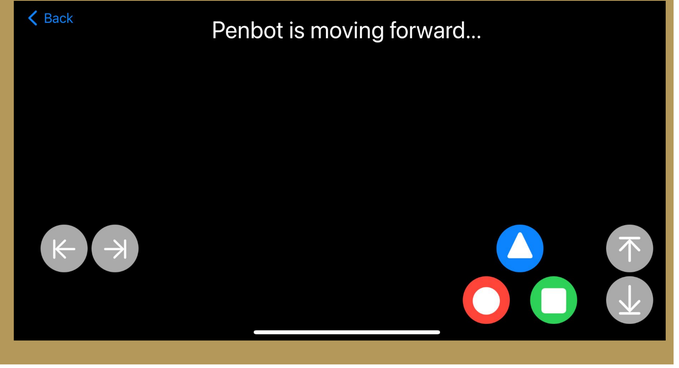


Mobile App UI

- A text label at the top of the screen that displays the expected action
- Main menu features commands to start, stop, pause drawing, or to continue drawing
- Drawing select menu shown at right



Virtual Remote Controller



Required Drawings

Drawing (max draw time)	Description
Simple Abstract (90 seconds)	A ~12” x 12” drawing of a recognizable object such as a flower, butterfly, guitar, cat, etc.
Portrait (5 minutes)	A portrait of a recognizable figure drawn to the size of standard poster board (22” x 28”)
Geometric (30 minutes)	An interesting and complex pattern of curved and straight lines that largely fills the area of the posterboard.
Landscape (1 hour)	A highly detailed natural landscape or cityscape.
Supersize (2 hours)	The bot must create a large drawing on 4 feet by 10 feet kraft paper. Must be highly detailed and can’t simply be a scaled up version of the other drawings.

Estimated Power Dissipation

Hardware	Quantity	Current (mA)	Power (W)
Raspberry Pi Pico	1	100	0.5
28BYJ-48 Stepper Motor	2	240	2.4
AT-09 Bluetooth 4.0 Module	1	9	0.045
Brushed DC Motor	1	220	1.1

Total Power: 4.045 W

Acknowledgements

- Dr. William Stapleton - Faculty Advisor
- Lee Hinkle - Sponsor
- Team M.A.R.U. - D2 Mentor